

What is claimed is:

- 1 1. An apparatus comprising:
 - 2 a transparent plate with an upper surface; and
 - 3 a plurality of spaced apart fiducials formed on the upper surface at locations
 - 4 corresponding to desired die locations.

- 1 2. The apparatus of claim 1, wherein the transparent plate is glass.

- 1 3. The apparatus of claim 2, wherein the glass is quartz.

- 1 4. The apparatus of claim 1, wherein the fiducials are formed by electron-beam
2 lithography.

- 1 5. The apparatus of claim 1, wherein the spaced apart fiducials have a
2 placement accuracy equal to or less than 2 microns, 3 sigma.

- 1 6. An apparatus comprising:
 - 2 a transparent plate having fiducials on a surface, the transparent plate
 - 3 adapted to be positioned beneath a panel having transparent segments so that a die
 - 4 suspended above the panel and having a die alignment mark can be aligned and
 - 5 positioned relative to at least one of the fiducials.

- 1 7. The apparatus of claim 6, wherein the transparent plate is made of glass.

- 1 8. The apparatus of claim 7, wherein the glass is quartz.

- 1 9. The apparatus of claim 6, wherein the fiducials are chrome.

1 10. An apparatus comprising:
2 a movable pick-up head capable of holding, positioning and releasing a die,
3 the die having an alignment mark;
4 a panel support member adapted to movably support a panel in a panel
5 support plane, the panel having upper and lower surfaces and an array of cavities
6 each open at the upper surface and each having a transparent bottom;
7 a transparent plate with fiducials arranged at locations corresponding to
8 desired die locations, the transparent plate arranged adjacent the panel support plane
9 opposite the movable pick-up head; and
10 an optical vision system adapted to image at least one fiducial and generate
11 an electrical signal corresponding to the position of the at least one fiducial.

1 11. The apparatus of claim 10, further including a controller electrically
2 connected to the pick-up head and the optical vision system, the controller adapted
3 to control the movement of the pick-up head in response to the electrical signal.

1 12. The apparatus of claim 10, wherein the transparent plate is made of glass.

1 13. The apparatus of claim 11, wherein the glass is quartz.

1 14. The apparatus of claim 10, wherein the fiducials are formed by electron-
2 beam lithography.

1 15. A method comprising:
2 providing a panel with a plurality of cavities, each cavity including an
3 opening to a panel upper surface and a transparent bottom at a panel lower surface;
4 arranging adjacent the panel lower surface a transparent plate having an
5 upper surface with a plurality of fiducials formed thereon, with one fiducial aligned
6 with the each cavity transparent bottom and serving as a local fiducial; and
7 imaging the local fiducial to align the die to the cavity.

1 16. The method of claim 15, further including determining a position of the die
2 relative to the local fiducial based on said imaging.

1 17. The method of claim 16, including generating an electrical signal
2 corresponding to the die position relative to the local fiducial.

1 18. The method of claim 17, further including aligning the die with the local
2 fiducial.

1 19. The method of claim 18, further including:
2 inserting the die into the opening of the cavity associated with the local
3 fiducial; and
4 contacting the die to the transparent bottom.

1 20. The method of claim 15, including forming the fiducials using electron-
2 beam lithography.

1 21. A method comprising:
2 forming fiducials on an upper surface of a transparent plate;
3 arranging the transparent plate relative to a panel having multiple cavities
4 formed in a panel upper surface, with each cavity having a transparent bottom, said
5 arranging including aligning each fiducial beneath a corresponding one of the
6 multiple cavities; and
7 imaging a select one of the fiducials corresponding to a select one of the
8 cavities to establish a die position relative to the select one of the cavities.

1 22. The method of claim 21, including making the transparent bottom adhesive.

1 23. The method of claim 21, including aligning the die alignment mark to the
2 select fiducial.

1 23. The method of claim 23, further including placing the die onto the
2 transparent bottom of the select cavity.

1 24. The method of claim 21, including imaging the die alignment mark
2 through the transparent bottom.